## PART I - ADMINISTRATIVE

## Section 1. General administrative information

**Title of project**

Evaluate Habitat Use And Population Dynamics Of Lampreys In Cedar Creek

**BPA project number:** 20121
**Contract renewal date (mm/yyyy):** ☐ **Multiple actions?**

**Business name of agency, institution or organization requesting funding**
U. S. Fish and Wildlife Service

**Business acronym (if appropriate)** USFWS

**Proposal contact person or principal investigator:**


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|---|---|
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**NPPC Program Measure Number(s) which this project addresses**
2.1, 2.1A, 2.2A, 3.2, 3.3, 7.1, 7.5F, 7.5F.1, 7.6, 7.6A, 10.2C

**FWS/NMFS Biological Opinion Number(s) which this project addresses**

**Other planning document references**
The report proceeding from measure 7.5F.1 of the Fish and Wildlife Program: Status report of the Pacific lamprey (Lampetra tridentata) in the Columbia River basin (BPA Project Number 94-026), Section III - Recommended Research, Subsections A, B, and C; coordination workshop (22-23 October 1998, Pendleton, Oregon) hosted by the Confederated Tribes of the Umatilla, contractees of BPA project 9402600, “Pacific lamprey research and restoration projects”.

**Short description**
With emphasis on Pacific lampreys, identify and quantitatively evaluate populations of lampreys and their habitats in a stream below Bonneville Dam

**Target species**

Pacific Lamprey, river lamprey, brook lamprey

## Section 2. Sorting and evaluation

**Subbasin**
Lower Columbia - Lewis River

### *Evaluation Process Sort*

| CBFWA caucus | Special evaluation process | ISRP project type |
|---|---|---|
| Mark one or more caucus | If your project fits either of these processes, mark one or both | Mark one or more categories |
| ☒ Anadromous fish<br>☒ Resident fish<br>☐ Wildlife | ☐ Multi-year (milestone-based evaluation)<br>☐ Watershed project evaluation | ☐ Watershed councils/model watersheds<br>☐ Information dissemination<br>☐ Operation & maintenance<br>☐ New construction<br>☒ Research & monitoring<br>☐ Implementation & management<br>☐ Wildlife habitat acquisitions |

## Section 3. Relationships to other Bonneville projects

***Umbrella / sub-proposal relationships.*** List umbrella project first.

| Project # | Project title/description |
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### *Other dependent or critically-related projects*

| Project # | Project title/description | Nature of relationship |
|---|---|---|
| 9402600 | Pacific lamprey research and restoration projects | Our proposed project will complement work being done under this contract, and meets mutually agreed upon research priorities identified at a workshop hosted by the contractees (22-23 October 1998, Pendleton, Oregon). |
| 0 | Evaluate status of Pac. lamprey in the Clearwater River drainage (Proposed) | Our proposed project will complement work proposed under this project because these projects will use the same methods to achieve |

| | | |
|---|---|---|
| | | similar goals and objectives. |
| 0 | Upstream migration of Pacific lampreys in the John Day River (Proposed) | Our proposed project will complement work proposed under this project because these projects will use the similar methods to achieve similar goals and objectives. |
| 0 | Cedar Creek natural production and watershed monitoring project. (Proposed) | Our proposed project will assist this project if both are funded by sharing equipment, personnel, and information. |
| | | |

## Section 4. Objectives, tasks and schedules

### *Past accomplishments*

| Year | Accomplishment | Met biological objectives? |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

### *Objectives and tasks*

| Obj 1,2,3 | Objective | Task a,b,c | Task |
|---|---|---|---|
| 1 | Estimate abundance, measure biological characteristics, determine migration timing of mature Pacific lampreys | a | Trap adult anadromous lampreys though the entire spawning run and measure their biological characteristics (length, weight, sex, and maturity). |
| | | b | Mark captured Pacific lampreys, release them downstream of the trap location, and estimate spawning run abundance from proportion of marked animals recaptured. |
| | | c | Capture and estimate abundance of adult resident (brook) lampreys by multi-pass depletion electrofishing |
| 2 | Determine larval lamprey distribution, habitat use, and biological characteristics. | a | Capture larval lampreys by electrofishing and measure their length, weight, and sex. |
| | | b | Evaluate habitat characteristics at ammocoete capture sites. |
| 3 | Determine outmigration timing | a | Capture outmigrant lampreys by |

| | | | |
|---|---|---|---|
| | and estimate abundance of recently metamorphosed lampreys. | | floating screw trap, mark and release these animals upstream of the trap site, and estimate abundance from the proportion of marked lampreys in subsequent samples. |
| 4 | Evaluate lamprey homing fidelity, survival rates, and ocean residence. | a | Tag outmigrant lamprey with coded wire tags (CWT) and monitor immigrant adults for CWT in subsequent years. |
| | | b | If CWT lamprey are recaptured, determine ocean residence time from time elapsed between tagging and recapture, and homing fidelity and survival rates from recapture percentages. |
| 5 | Verify diagnostic characteristics of larval lampreys and evaluate effects of Passive Integrated Transponder (PIT) tags. | a | Rear ammocoetes through metamorphosis to verify species identifications. |
| | | b | Collect large ammocoetes and recently metamorphosed Pacific lampreys and evaluate effects and success of PIT tag placement in controlled experiments in the laboratory. |
| 6 | Evaluate spawning habitat requirements of adult lampreys. | a | Conduct weekly surveys during potential spawning periods to identify lamprey spawning locations and redds. |
| | | b | Measure physical characteristics of redds, including redd size, depth in the water column, water velocity, substrate, habitat type, and presence of cover and shading. |
| | | c | Sample redds to evaluate the occurrence of unused redds. |
| | | d | Cap redds to determine developmental timing and survival of lamprey eggs and larvae. |

### *Objective schedules and costs*

| Obj # | Start date mm/yyyy | End date mm/yyyy | Measureable biological objective(s) | Milestone | FY2000 Cost % |
|---|---|---|---|---|---|
| 1 | 10/1999 | 9/2003 | Abundance, biological characteristics, and | | 20.00% |

| | | | | | |
|---|---|---|---|---|---|
| | | | migration timing of mature Pacific lampreys | | |
| 2 | 10/1999 | 9/2003 | Larval lamprey distribution, habitat use, and biological characteristics. | | 30.00% |
| 3 | 10/1999 | 9/2003 | Abundance and migration timing of emigrant juvenile lamprey. | | 30.00% |
| 4 | 10/1999 | 9/2003 | Lamprey homing fidelity, survival rates to adults, and ocean residence times. | | 5.00% |
| 5 | 10/1999 | 9/2003 | Protocol for PIT tagging lamprey and verified larval lamprey keys. | | 5.00% |
| 6 | 10/1999 | 9/2003 | Lamprey spawning habitat characteristics. | | 10.00% |
| | | | | **Total** | 100.00% |

**Schedule constraints**
ESA permits

**Completion date**
2003

## Section 5. Budget

**FY99 project budget (BPA obligated):** $138,790

### *FY2000 budget by line item*

| **Item** | **Note** | **% of total** | **FY2000** |
|---|---|---|---|
| Personnel | 100% team leader, two-75% technicians. | %57 | 79000 |
| Fringe benefits | 28% for all team members | %12 | 16,500 |
| Supplies, materials, non-expendable property | Nets, traps, sample bottles, and misc. field gear. | %2 | 3,000 |
| Operations & maintenance | Vehicle and equipment operation. | %7 | 10,000 |
| Capital acquisitions or improvements (e.g. land, buildings, major equip.) | 0 | %0 | 0 |
| NEPA costs | | %0 | |

| | | | |
|---|---|---|---|
| Construction-related support | 0 | %0 | 0 |
| PIT tags | # of tags: 100 | %0 | 290 |
| Travel | Travel to meetings and occasional overnight field work. | %2 | 3,000 |
| Indirect costs | 22% of total | %19 | 27,000 |
| Subcontractor | 0 | %0 | 0 |
| Other | 0 | %0 | 0 |
| | | **TOTAL BPA FY2000 BUDGET REQUEST** | $138,790 |

### *Cost sharing*

| **Organization** | **Item or service provided** | **% total project cost (incl. BPA)** | **Amount ($)** |
|---|---|---|---|
| WDFW | Checking adult and juvenile traps | %6 | 12,000 |
| USGS-BRD-CRRL | Laboratory space for rearing lamprey through metamorphosis and for PIT tag experiments | %2 | 5,000 |
| USGS-BRD-CRRL | Technical assistance for trapping and identification of ammocoetes | %7 | 13,200 |
| USFWS | Office space rental | %2 | 4,800 |
| USFWS | Supervisory biologist | %7 | 13200 |
| USFWS | Screw traps, adult weir, misc. trapping equipment | %7 | 15,000 |
| | | **Total project cost (including BPA portion)** | $201,990 |

### *Outyear costs*

| | **FY2001** | **FY02** | **FY03** | **FY04** |
|---|---|---|---|---|
| **Total budget** | $160,000 | $170,000 | $180,000 | |

## Section 6. References


| **Watershed?** | **Reference** |
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| ☐ | Bergstedt, R.A., W.D. Swink, and J.G. Seelye. 1993. Evaluation of two locations for coded wire tags in larval and small parasitic-phase sea lampreys. North American Journal of Fisheries Management 13:609-612. |
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| ☐ | Holmes, J.A. and P. Lin. 1994. Thermal niche of larval sea lamprey, Petromyzon marinus. Canadian Journal of Fisheries and Aquatic Sciences 51:253-262. |
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| ☐ | |

# PART II - NARRATIVE

## Section 7. Abstract

Pacific lampreys (*Lampetra tridentata*) in the Columbia River Basin (CRB) have declined to a remnant of their pre-1940s populations. The ecological, economic, and cultural significance of this species is underestimated by most casual observers. NPPC-FWP sections 7.5F and 7.5F.1 noted this decline and requested a status report identifying research needs. Among needs identified by this report were abundance, current distribution and habitat limitation studies. Studies of the biology, population dynamics, ecology, identification, and relationships of Pacific lamprey with the two other species of lampreys *(L. ayresi*, and *L. richardsoni*) coexisting in the CRB will assist in rehabilitating the Pacific lamprey populations. Quantitative baseline data including lamprey population dynamics, length-frequency relationships, spawning-phase adult abundance estimates, and larval habitat requirements will be collected and quantatively described from a Pacific lamprey population that has open access to the ocean. Representative samples of larvae will be reared in captivity to evaluate the accuracy and precision of identification keys. Methods will be taken from the literature developed from 40 years of studying sea lampreys (*Petromyzon marinus*). Specific products of this study will include: years three and four, manuscripts describing species-specific age, growth and fecundity, homing, migration timing and ocean residence of anadromous lampreys, and ecological and inter-specific interactions of larval lampreys, including habitat selection and limiting factors. The quality of the work will be judged by the peer review of the written and verbal infomation presented.

## Section 8. Project description

### a. Technical and/or scientific background

Three lamprey species (*Lampetra tridentata, L. ayresi*, and *L. richardsoni*) include the Columbia River Basin within their geographic ranges (Kan 1975). Pacific lampreys (*Lampetra tridentata*) in the Columbia River Basin (CRB) have declined to only a remnant of their pre-1940s populations (Close et al. 1995). The ecological, economic, and cultural significance of this species is grossly underestimated by most casual observers (Kan 1975, NPPC 1995, Close et al. 1995). Actions are currently being considered for its recovery of the Pacific lamprey populations in the CRB (Close et al. 1995). The status of *Lampetra ayresi* and *L. richardsoni* is unknown. Whereas some biological and ecological information for these species is available from studies conducted outside the CRB in Canada (e.g. Pletcher 1963, Beamish 1980, Richards 1980, Beamish and Levings 1991), they have been poorly studied within the CRB (Kan 1975, Hammonds 1979).

Identifying which biological and ecological factors limit lampreys in the CRB is critical for their recovery. In particular, understanding factors influencing reproduction and survival of early life history stages is important since this period may be critical to the determination of recruitment to the population (Houde 1987). Larval lamprey (ammocoete) abundance may be determined by water temperatures during early larval development or by other physical habitat characteristics (Potter et al. 1986, Young et al. 1990, Youson et al. 1993). For sea lamprey ammocoetes, the range of optimal temperatures is narrow, 17.8 to 21.8 C (Holmes and Lin 1994). Other fundamental biological questions remain unanswered. For example, sea lamprey do not exhibit a homing instinct to natal streams (Bergstedt and Seelye 1995) but instead appear to respond to the bile salts released by conspecific larval lamprey (Li et al. 1995). No information exists on homing of Pacific lampreys. The success of any rehabilitation effort of Pacific lampreys could depend on our knowing whether stocks of Pacific lampreys exist in the CRB. Passive Integrated Transponder (PIT) tag or Coded Wire Tag (CWT) studies with large numbers of recently metamorphosed Pacific lampreys and a well established upstream migrant population assessment program are required to answer this question. In preparation for a large scale homing study, this proposed study will evaluate our ability to PIT tag recently metamorphosed Pacific lampreys and will also provide the first quantitative estimate of a run of upstream migrating Pacific lampreys using a standard population estimation technique.

The lack of knowledge of CRB lamprey species extends to the identification of the larval phase. Identification of larval lampreys of these species is not well resolved (Richards et al. 1982, Bond 1994). Current distribution of lampreys in the CRB will most likely be done by electroshocking ammocoetes. Since larval lampreys are readily collected from rearing areas in the wild by this method, the ability to identify this lifestage is a necessity to determine distribution and abundance of lampreys in the CRB. We will verify our field identifications by rearing lamprey through metamorphosis in the laboratory.

This project represents a baseline study to provide important data on the population dynamics and habitat use of lampreys in the CRB. We will produce abundance estimation for several life stages of lampreys, appraise movement patterns of larval lampreys, evaluate accuracy of current larval lamprey identification keys, assess homing fidelity and measure habitat quality. Furthermore, this study will use these techniques to determine factors limiting populations of Pacific lampreys. This infomation is necessary for the successful restoration of Pacific lampreys in the CRB. Thus, results of this study will have broad utility for studies and restoration monitoring in the CRB and other areas in the Northwest.

Initially, the techniques which will be evaluated for CRB lamprey species will be those which have been successfully used in study and management of sea lampreys in the

Great Lakes (e.g. Volk 1986, Bergstedt et al. 1993, Pajos and Weise 1994, Berstedt and Genovese 1994). These techniques will be modified as necessary to meet the requirements of the CRB environment.

This study will be conducted in Cedar Creek, a third-order tributary to the Lewis River at Lewis River mile 15.7. The Lewis River enters the Columbia River at Columbia River mile 87. The Cedar Creek drainage includes 55.5 $mi^2$ of diverse stream types and habitat conditions, contains five major tributaries (Chelatchie, Pup, Bitter, Rush, and John Creeks), and is inhabited by *Lampetra tridentata*, *L. richardsoni*, and possibly *L. ayresi* (D. Rawding, Washington Department of Fish and Wildlife, pers. comm.). Cedar Creek, a WDFW sanctuary watershed, also has intact native species assemblages, including anadromous salmonids such as summer and winter steelhead, searun cutthroat, coho, and fall chinook (WDFW and USFWS, unpublished data). Sanctuary watershed status means that Cedar Creek is closed to angling and is managed for wild fish. Whereas over 150 miles of the mainstem Lewis and upstream tributaries have been impacted by impassable hydropower developments, access to Cedar Creek is uninhibited by either these dams or by the effects of mainstem Columbia River hydropower development. This is important, because dam passage appears to heavily limit adult lamprey movements, as telemetry studies show that less than half of lamprey attempting to pass Bonneville dam are successful (J. Vella, National Marine Fisheries Service, pers. comm.). Consequently, studies to determine baseline life history requirements conducted above Bonneville Dam are inherently biased by the influence of hydropower facilities, both on lampreys themselves, and on their native anadromous salmonid communities. Therefore, conducting this study in Cedar Creek will provide a valuable baseline dataset against which similar studies conducted above Bonneville Dam can be compared. Furthermore, this study is integral to cooperative efforts of WDFW and USFWS to guide, and evaluate, coordinated habitat protection, restoration, and enhancement projects ongoing in the basin.

## b. Rationale and significance to Regional Programs

This project relates very specifically to sections 7.5F and 7.5F.1 of the NPPC Fish and Wildlife Program (1994) which noted the apparent decline of the Pacific lamprey in the CRB and requested a status report to identify research needs. Section three of the resulting report (Close et al. 1995) outlines these research needs (in part): section III.A, abundance studies; section III.B, current distribution; and, section III.D, determine habitat limiting factors. This project will (1) develop techniques to collect these types of information, and (2) provide baseline data in all three of these areas from a stream not influenced by mainstem hydropower development. This is important because dam passage appears to heavily limit adult lamprey movements, as telemetry studies show that less than half of lamprey attempting to pass Bonneville dam are successful (J. Vella, National Marine Fisheries Service, pers. comm.). Close et al. (1995) also list the identification of potential applications of transplantation and artificial production (section III.E and section III.F) as research needs. Both technological and biological results of this study will allow informed decisions on the efficacy of these needs.

This project relates to other sections of the Fish and Wildlife Program as well:

2.1- …Healthy Columbia River Basin. This section specifically recognizes the need to "…protect and enhance the ecosystem…", and this project's goal is to understand the relationship of lamprey in the CRB ecosystem, and to identify ways of protecting and recovering lamprey in the CRB.

2.1A- Assess Ecological Health of the CRB. This project will evaluate an important ecosystem component and its relationship to other components (salmon, etc.).

2.2A- Support Native Species in Native Habitat. This project will support not only lampreys in their native habitat but will also aid a WDFW and USFWS program to monitor and enhance native fish natural production in Cedar Creek, which is critical for the Lewis River drainage in general. Furthermore, because mainstem dams appear to limit lamprey production, maintenance of lamprey in habitats downstream of Bonneville dam is critical.

3.2- Monitoring and Evaluation. This project is part of a Cedar Creek cooperative USFWS and WDFW M&E program, and lamprey results will help guide management actions not only in Cedar Creek, but systemwide as well.

3.3- …Coodinated Information System… This project will provide its data to this system for ease of dissemination at the conclusion of the study.

7.1- Ensure Biodiversity- This project will provide a great deal of information about little known organisms, and their preservation, and therefore will help maintain the native biodiversity of the CRB.

7.6, 7.6A- Habitat… This project will provide information critical to the protection and restoration of habitat important for lamprey, both in Cedar Creek and in the CRB as a whole.

10.2C- Comprehensive Watershed Management- This project is part of a multi-group effort to manage Cedar Creek watershed for multiple native species by protecting, restoring, and enhancing habitat and by monitoring and evaluating biological responses. This project will be part of a joint WDFW, USFWS effort to establish baseline conditions.

## c. Relationships to other projects

Our proposed project will complement both current and proposed lamprey work in the CRB. Our research objectives target mutually agreed upon research priorities identified at a workshop (22-23 October 1998, Pendleton, Oregon) hosted by the Confederated Tribes of the Umatilla, contractees of BPA project 9402600, "Pacific lamprey research and restoration projects". Attendees of this workshop agreed to coordinate activities, including using common methods for capturing adult and ammocoete lamprey and for evaluating habitat use, and providing ammocoetes to USGS Biological Resources Division Columbia River Research Laboratory (CRRL) for rearing through metamorphosis to verify identifications. Our proposed project also is part of a partnership with WDFW to evaluate and determine ecological relationships of fish populations in Cedar Creek. These efforts are designed to guide, and evaluate, coordinated habitat protection, restoration, and enhancement projects ongoing in the basin by Clark County, National Resource Conservation Service, Clark County Conservation District, Pacificorps, WDFW, USFWS, and Fish First.

**d. Project history** (for ongoing projects)

This is a new, proposed project.

**e. Proposal objectives**

1. Estimate abundance, determine migration timing, and measure biological characteristics of mature lampreys in Cedar Creek.

Hypotheses tested ($H_o$):

1. Populations migrating up Cedar Creek are consistent from year to year.
2. Migration takes place throughout the year.
3. Biological characteristics are uniform throughout the spawning migration of lampreys in Cedar Creek.
4. Sex ratios are equal (1:1) within specific spawning populations of lampreys.
5. Biological characteristics are equivalent inter-sexually.

2. Determine biological characteristics, habitat use, and distribution of larval lampreys in Cedar Creek.

Hypotheses tested ($H_o$):

1. Larval lamprey distribution and habitat use is uniform longitudinally and temporally in Cedar Creek.
2. Larval lamprey distribution and habitat use is uniform throughout all habitat types in Cedar Creek.
3. Larval lamprey distribution and habitat use is uniform inter-specifically in Cedar Creek.
4. Larval lamprey distribution and habitat use is uniform among differing size classes of larval lampreys in Cedar Creek, both inter- and intra-specifically.

3. Determine outmigration timing and estimate abundance of young adult anadromous lampreys.

4. Evaluate Pacific lamprey homing fidelity, survival rates, and ocean residence.

Hypotheses tested ($H_o$):

1. Pacific lamprey do not home to natal streams.

5. Evaluate accuracy of dichotomous keys for larvae of each species and evaluate effects of internal PIT tag placement in ammocoete and young adult lampreys in the laboratory.

Hypotheses tested ($H_o$):

1. Dichotomous keys for larval lampreys of different species are accurate for larval lampreys regardless of the location of capture in the CRB.
2. Tagged and untagged lampreys survive equally.

3. Lamprey survival and tag retention are equal regardless of tag placement.

6. Evaluate spawning habitat requirements of adult lampreys.
Hypotheses tested ($H_o$):
1. Redd sites are uniformly distributed longitudinally and across habitat types in Cedar Creek.
2. All redds contain developing embryos.
3. Lamprey survival is 100% within individual redds.

**f. Methods**

Tasks associated with Objective 1:

Adult anadromous lampreys will be trapped at the falls about 3.2 km above the confluence of Cedar Creek with the Lewis River. Lampreys will be trapped in lighted box traps (Purvis et.al. 1985) set along the base of the falls. Captured animals will be anesthetized with MS-222 (Summerfeldt and Smith 1990), biological data (length, weight, sex) gathered, physically marked, and released downstream of the trap location. A number of combinations of V-shaped notches (Manion et.al. 1988) in the dorsal fin will be used weekly to create unique marks in weekly lots of fish. Spawning population abundance will be estimated from the proportion of marked adult lampreys among subsequent lots of captured lampreys (Sheaffer et al. 1990). This method assumes that marked individuals will mix uniformly with unmarked fish, that the population is closed during the time of estimation, and that marked and unmarked lampreys have equal probabilities of capture. These assumptions could be violated if marked lampreys behave differently than unmarked fish, if marked fish do not try to re-ascend the falls, or if marked lampreys experience higher mortality than unmarked fish.

Adult brook lampreys will be captured by electrofishing in Cedar Creek. Population abundance will be estimated by using removal methods (Zippin 1956). After the last removal pass, adult lampreys will be anesthetized, biological data gathered, marked with a pig ear punch, and released. Initially, abundance will be estimated in thirty 30 m sections of Cedar Creek and in ten 30 m sections in each major tributary stream. If channel types are highly variable within a creek, strata will be developed by channel type, and at least 10 samples chosen from each strata. If variance is high within a creek or stratum, sample sizes will be increased as much as reasonable sampling effort allows (Schaeffer et al. 1990, Sokal and Rolff 1995). Relationships within collected data will be analyzed by ANOVA (Sokal and Rolff 1995) and other methods as necessary.

Tasks associated with Objective 2:

The longitudinal distribution of larval lamprey will be determined randomly selecting 30 m reaches from Cedar Creek and its major tributaries to sample for larval lampreys. These reaches will be chosen in the same manner as for Objective 1. Habitat types will be characterized (Hawkins et al. 1988). Ammocoetes will be captured by electrofishing (Pajos and Weise 1994). Each larval lamprey will be identified to species and its length (mm) and weight (g) measured. Habitat used by these ammocoetes will be described by measuring water velocity, depth, conductivity, temperature, gradient, habitat type, substrate size, and canopy density (Platts et al. 1983). Measuring substrate size and canopy density (Platts et al. 1983); water velocity, depth, conductivity, and temperature; gradient; and habitat type at the locations where these ammocoetes are collected will determine the habitat used by these ammocoetes. Relationships within collected data will be analyzed by ANOVA (Sokal and Rolff 1995) and other methods as necessary.

Tasks associated with Objective 3:

Outmigrant young adult lampreys will be captured by a floating rotary screw trap (constructed by E.G. Solutions, Inc., Corvallis, OR) with an eight-foot diameter cone placed in the pool downstream of Grist Mill falls in Cedar Creek. This trap will be placed in the stream in November of each year and will be left in place until the outmigration of anadromous young adult lamprey concludes. This trapping schedule will be modified as necessary in subsequent trapping years. Each captured lamprey will be identified to species, length (mm) and weight (g) recorded, marked with a V-notch punch in its dorsal fin, transported 400 m upstream of the trap, and released. Outmigrant abundance will be estimated from the proportion of marked lampreys in subsequent lots of lampreys captured (Roper and Scarnecchia 1996). Accuracy of this method depends on marked and unmarked lampreys having equal capture efficiency.

Tasks associated with Objective 4:

Sea lamprey do not appear to home (Bergstedt and Seelye 1995), and because information on Pacific lamprey homing does not exist and because such knowledge is critical to recovering populations, we propose to CWT all outmigrant lamprey captured by screw trapping. Only if large numbers of outmigrants can be captured and if a reasonable number return to Cedar Creek can we expect useful data on homing and survival rates. Furthermore, data on ocean residence time will be reliably gathered only if reasonable numbers of tagged lamprey return to Cedar Creek.

Tasks associated with Objective 5:

Larval lamprey identification can be difficult (Bond 1994); only 61% of ammocoetes reared by USFWS and USGS through metamorphosis were accurately identified (USFWS, unpublished data, 1998). Therefore, a sample of ammocoetes captured by electrofishing (under task 2) will be transported to CRRL for rearing to validate field identifications, and to assist CRRL in its efforts to develop reliable identification methods for Columbia River basin lamprey.

Tasks associated with Objective 6:

Lamprey redds will be identified by weekly foot surveys during the spawning period. Physical characteristics of redds will be measured, including: redd dimensions, depth in the water column, water velocity, habitat type (Hawkins et al. 1993), and substrate and the amount of cover or shading at the redd location (Platts et al. 1983). Five redds of each species will be covered with redd caps, modified from Porter (1973), and five additional redds of each species will be excavated to evaluate false nesting, embryo development time and survival under ambient conditions.

All statistical tests will be computed by the program SAS (SAS 1989).

## g. Facilities and equipment

Existing facilities at USFWS, Columbia River Fisheries Program Office and USGS - BRD, Columbia River Research Laboratory are adequate for the purposes of this study.

- USFWS CRFPO has adequate office space, microcomputers, and statistical software suitable for data entry, statistical analysis, manuscript and report preparation.

- USFWS CRFPO maintain a fleet of GSA and Department of Interior motor vehicles; these vehicles are generally replaced every 60,000 miles, and therefore remain in reasonable working order.

- The USGS BRD station has adequate rearing and laboratory facilities for lamprey rearing and PIT tag experiments.

- USFWS CRFPO has suitable backpack electrofishers, dipnets, balances, redd caps, McNeil substrate samplers, Marsh-McBirney water velocity meters, conductivity meters and measuring boards in good working order for capturing larval lamprey and collecting ammocoete and adult biological and physical habitat information.

- USFWS CRFPO maintains six floating screw traps in five- and eight-foot sizes for capturing outmigrating fish in lotic environments.

Adult lamprey traps will be constructed for this project, and materials for these will be purchased with project funds. Tagging and marking materials will also need to be purchased with project funds, including PIT tags, pig ear punches, and so forth.

## h. Budget

Over 30% of the total budget of this project will be met by various cost sharing arrangements, including technical assistance time donated by CRRL; office space, computers, GPS receivers, trapping equipment, and supervisory fishery biologist time provided by the USFWS; and technician assistance offered by WDFW for adult and juvenile trapping.

In addition, the USFWS crew is stationed close enough to the study area so that travel and per diem costs will be held to a minimum and supplementary training of crew members will not be necessary.

## Section 9. Key personnel

Scott A. Barndt, Paul A. Ocker, and Travis C. Coley are currently monitoring lamprey species composition, spawning habitat characteristics, young adult outmigration abundance and timing, and adult spawning run sizes in conjunction with salmonid monitoring, habitat evaluation, and habitat restoration projects (USFWS, unpublished data). Dr. James G. Seelye directed a research program on sea lampreys (*Petromyzon marinus*) in the Great Lakes for 13 years, studying biology, ecology, and associated research topics as they relate to lampreys (Seelye et al. 1987, Bergstedt and Seelye 1995, Bergstedt et al. 1993, Youson et al. 1993, Holmes et al. 1994) and will serve as general technical advisor to this project.

(Resumes follow on the next page)

**Resumes**:

Name: Travis C. Coley

Present Position: U.S. Fish and Wildlife Service
Columbia River Fisheries Program Office
9317 N. E. Highway 99, Suite I
Vancouver, WA 98665

Education and Training:

| Degree | Date | School |
|---|---|---|
| B.S. Fisheries Management | 1976 | Mississippi State University |
| M.S. Fisheries Resources | 1979 | University of Idaho |

Experience:

1991-present Team leader, Habitat and Natural Production Team, Columbia River Fisheries Program Office

Supervises a staff of 12 biologists and technicians working primarily on habitat assessment, habitat restoration, and fish population assessment and monitoring. Has supervised chum salmon monitoring and watershed analysis of Hardy Creek on Pierce National Wildlife Refuge.

1986-1991 Assistant Project Leader of the Idaho Fisheries Resources Office, U. S. Fish and Wildlife Service, Ahsahka, Idaho.

1978-1986 Northwest and Alaska Fisheries Center, National Marine Fisheries Service, Hammond, OR

Pertinent Reports and Publications:

Muir, W.D. and T.C. Coley. 1996. Diet of yearling chinook salmon and feeding success during downstream migration in the Snake and Columbia Rivers. Northwest Science 70 (298-305).

Muir, W.D., A.E. Giorgi, and T.C. Coley. 1994. Behavioral and physiological changes in yearling chinook salmon during hatchery residence and downstream migration. Aquaculture 127(69-82).

McCabe, G.T., Jr., R.L. Emmett, T.C. Coley, and R.J. McConnell. 1988. Distribution, density, and size class structure of Dungeness crab in the river-dominated Columbia River estuary. Northwest Science 62(5):254-262.

Giorgi, A.E., G.A. Swan, W.S. Zaugg, T.C. Coley, and T.Y. Barila. 1988. Susceptibility of chinook salmon smolts to bypass systems at hydroelectric dams. North American Journal of Fisheries Management 8:25-29.

McCabe, G.T., Jr., R.L. Emmett, T.C. Coley, and R.J. McConnell. 1987. Effects of a river dominated estuary on the prevalence of *Crinonemertes errans*, an egg predator of the Dungeness crab, *Cancer magister*. Fishery Bulletin 85:140-142.

**Paul A. Ocker – Field Crew Leader for proposed work**

**Current Position**: Fishery Biologist Management, GS-09
Field Crew Supervisor

**Education:**

| | | | |
|---|---|---|---|
| B.S. | Biological Sciences | 1991 | California Polytechnic State University |
| | Marine Biology | 1988 | University of Oregon at Charleston (OIMB) |

**Experience:**

Associate Scientist 3, Robert Schlotterbeck Inc., Avila Beach, California, Biological Monitoring of Nuclear Facility, 1989
Fishery Biologist Technician, US Forest Service, Hebo, Oregon, Hankin-Reeves Stream Survey, 1990
Park Ranger – Resource Mgmt, National Park Service, Homestead, Florida, Water Quality and Sport Fisheries Program, 1991-92
Fishery Biologist – Research, National Marine Fisheries Service, Pasco, Washington, Radio Telemetry and PIT tag Studies, 1993-95
Fishery Biologist – Management, US Fish and Wildlife Service, Vancouver, Washington, Instream Flow Program Field Crew Leader, 1995-present

**Current Assignment:**

Over the past three years I have been the field crew leader for the US Fish and Wildlife Services sub-contract of BPA project 86-50, known as the White Sturgeon Project, and BPA project 99-003 the project dealing with fall chinook and chum salmon spawning downstream from Bonneville Dam. Both of these projects have involved conducting flow studies to determine optimum spawning flows for the designated species. I have also been involved with other flow studies and have assisted in various other projects ranging from stream rehabilitation and smolt trapping to wildlife issues.

**Co-Authorships:-**

*Biological Evaluation of the Prototype Gatewell Lift-Tank System at Lower Granite Dam,* 1994, NMFS
*Survival Estimates for the Passage of Juvenile Salmonids through Snake RiverDams and Reservoirs*, 1994 , NMFS
*Relative Survival of Juvenile Chinook Salmon through Spillbays and the Tailrace at Lower Monumental Dam,* 1995 , NMFS
*Survival Estimates for the Passage of Juvenile Salmonids through Snake River Dams and Reservoirs,* 1995 , NMFS
*Migrational Characteristics of Adult Spring, Summer and Fall Chinook Salmon Passing through Reservoirs and Dams of the Mid-Columbia River,* 1995, NMFS
*Juvenile radio-telemetry study at Ice Harbor Dam,* 1995, NMFS
*Effects of Mitigative Measures on Productivity of White Sturgeon Populations in the Columbia River Downstream from McNary Dam, and Determine Status and Habitat Requirements of White Sturgeon Populations in the Columbia and Snake Rivers Upstream from McNary Dam* - BPA Annual Report - Section E – In Press, 1995, USFWS
*Effects of Mitigative Measures on Productivity of White Sturgeon Populations in the Columbia River Downstream from McNary Dam, and Determine Status and Habitat Requirements of White Sturgeon Populations in the Columbia and Snake Rivers Upstream from McNary Dam* - BPA Annual Report - Section E – To Press, 1996, USFWS

**Scott A. Barndt - Field Crew Leader for proposed work**

**Current Position:** Fishery Biologist Management, GS-07
Field Crew Supervisor

**Education:**

| | | |
|---|---|---|
| B.S. Fish and Wildlife Management | 1994 | Montana State University, Bozeman, Montana |
| M.S. Biology | 1996 | Montana State Univerisity, Bozeman, Montana |

**Experience:**

Laboratory and field technician, USDA-Agriculture Research Service, Bozeman, Montana. Conducted lab and field studies on biocontrol of noxious weeds with insects. 1990-94.

Laboratory technician, Montana State University, Bozeman, Montana. Analyzed coyote food habits. 1993.

Graduate research assistant, Montana State University, Bozeman, Montana. Studied arctic grayling movements, habitat use, biological characteristics, and ecological relationships. 1994-96.

Graduate teaching assistant, Montana State University, Bozeman, Montana. Taught ichthyology and mammology laboratory courses. 1996.

Fisheries biologist, Management, US Fish and Wildlife Service, Vancouver, Washington. Conduct habitat assessment, habitat restoration, and fish population assessment and monitoring studies. 1997-present.

**Current Assignment:**

Over the last two years I have participated in over 13 studies and projects, including juvenile and adult salmonid trapping and tagging projects, habitat assessments, and habitat restorations. Most recently, I have been a crew leader for a watershed analysis of a small SW Washington drainage, for chum and coho salmon monitoring activities, and for lamprey identification, habitat use, and tagging studies.

**Publications:**


Barndt, S.A. 1996. Biology and status of the grayling in Sunnyslope Canal, Montana. M.S. thesis. Montana State University, Bozeman, Montana.

Barndt, S.A. and C.M. Kaya. Reproduction, growth, and winter habitat of Arctic grayling in an irrigation canal which flows only during spring and summer. *In preparation*.

Barndt, S.A., T.C. Coley, B. Ensign, and J. Taylor. Watershed analysis of Gibbons Creek, Washington. *In preparation.*

**James G. Seelye**--principal technical advisor for proposed work

***Current Position:*** Supervisory Fishery Biologist, GS-14
Laboratory Director
Columbia River Research Laboratory
Cook-Underwood Road
Cook, Washington 98605

***Education and Training:***

| Degree | | Date | School |
|---|---|---|---|
| B.S. | Biological Science | 1969 | Lake Superior State College |
| M.S. | Limnology | 1971 | Michigan State University |
| Ph.D. | Limnology | 1975 | Michigan State University |

***Experience:***

Research Limnologist, Project Manager, USACE, Waterways Experiment Station, 1975-1976

Supervisory Fishery Biologist (Research), Project Leader, FWS, Contaminant Dynamics, Great Lakes Fishery Laboratory, 1976-1982

Supervisory Fishery Biologist (Research), Station Chief, FWS, Hammond Bay Biological Station, 1982-1995

Supervisory Fishery Biologist, Director, USGS/BRD, Columbia River Research Laboratory, 1995 to present

***Current Assignment:*** I am currently the Director at the CRRL, a major fishery research lab on the Columbia River. I have provided advice and assistance to lamprey researchers in the US and Canada for almost 20 years. Members of my staff and I are funded to conduct studies of the physiological effects of the fish bypass facilities at the Bonniville Dam. I provide advice and assistance to Dave Close with the CTUIR on their studies on a regular basis. I maintain a working relationship with the staff working on sea lampreys in the Great Lakes.

***Selected Publications:***


Seelye, J. G., L. L. Marking, E. L. King, Jr., L. H. Hanson, and T. D. Bills. 1987. Toxicity of TFM lampricide to early life stages of walleye. North American Journal of Fisheries Management 7:598-601.

Bergstedt, R. A., W. D. Swink, and J. G. Seelye. 1993. Evaluation of two locations for coded wire tags in larval and small parasitic-phase sea lampreys. North American Journal of Fisheries Management 13:609-6120.

Youson, Y. H., J. A. Holmes, J. A. Guchardi, J. G. Seelye, R. E. Beaver, J. E. Gersmehl, S. A. Sower, and F. W. H. Beamish. 1993. Importance of condition factor and the influence of water temperature and photoperiod on metamorphosis of sea lamprey, Petromyzon marinus. Canadian Journal of Fisheries and Aquatic Sciences 50:2448-2456.

Bergstedt, R. A., and J. G. Seelye. 1995. Evidence for lack of homing by sea lampreys. Transactions of the American Fisheries Society 124:235-239.

Fredricks, Kim T. and James G. Seelye. 1995. Flowing-recirculated water system for inducing spawning phase sea lampreys to spawn in the laboratory. Progressive Fish Culturist 57:297-301.

## Section 10. Information/technology transfer

Results from this study will be published in peer-reviewed journals and annual reports. Specific products of this study will include: syntheses of life history-specific marking and trapping techniques; species-specific age, growth and fecundity; migration timing of anadromous lampreys; homing fidelity and ocean residence timing; and ecological and inter-specific interactions of larval lampreys, including habitat selection and limiting factors. We expect to fully coordinate activities and methods, and present results through meetings with other CRB lamprey researchers.

## Congratulations!